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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/976,931	10/11/2001	Clifford L. Hersh	PA1951US	2047

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EXAMINER	
ALI, SYED J	

ART UNIT	PAPER NUMBER
2195	

DATE MAILED: 09/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/976,931	HERSH, CLIFFORD L.	
	Examiner	Art Unit	
	Syed J. Ali	2195	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 June 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7,10,13,15 and 17-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7,10,13,15 and 17-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This office action is in response to the amendment filed June 13, 2005. Claims 1-7, 10, 13, 15, and 17-26 are presented for examination.

2. The text of those sections of Title 35, U.S. code not included in this office action can be found in a prior office action.

Claim Objections

3. **Claims 19 and 22 are objected to because of the following informalities:**

a. In line 8 of claim 19, "operation" should read "operation tasks".

b. In line 2 of claim 22, "data tree" should read "tree data".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

4. **Claims 1-7, 10, 13, and 17-26 are rejected under 35 U.S.C. 102(b) as being anticipated by Larsen et al. ("B-Trees With Relaxed Balance") (hereinafter Larsen).**

5. As per claim 1, Larsen teaches the invention as claimed, including a method of reducing the number of times a tree data structure is rebalanced (§ 1) comprising the steps of:

(a) allowing a sub-tree of the data tree structure to grow unbalanced to a threshold level greater than one (§§ 1, 3); and

(b) rebalancing the data tree structure when the threshold level is reached (§ 4).

6. As per claim 2, Larsen teaches the invention as claimed, including the method of claim 1 wherein the threshold level is $\log_2 n$ for a tree data structure having about n nodes (§§ 3, 5).

7. As per claim 3, Larsen teaches the invention as claimed, including the method of claim 1 wherein the threshold level is a constant number of levels greater than a level of a balanced portion of the tree data structure (§§ 3, 5).

8. As per claim 4, Larsen teaches the invention as claimed, including the method of claim 1 wherein the step of rebalancing the tree data structure further comprises:

(a) developing first and second sets of rebalancing operation tasks, the first set of operation tasks operable to effect a first set of element state transitions and the second set of operation tasks operable to effect a second set of element state transitions, the first and second set of element state transition being distinct one from the other (§ 4, "Split" and "Compress");

(b) performing the first set of operation tasks in a first phase (§ 5); and

(c) performing the second set of operation tasks in a second phase (§ 5).

9. As per claim 5, Larsen teaches the invention as claimed, including a method of deferring the rebalancing of a tree data structure comprising the steps of:

(a) allowing a sub-tree of the tree data structure to grow unbalanced to a length greater than one (§§ 1, 3); and

(b) rebalancing the tree data structure when the length of the sub-tree reaches a threshold reached (§ 4).

10. As per claim 6, Larsen teaches the invention as claimed, including the method of claim 5 wherein the threshold level is $\log_2 n$ for a tree data structure having about n nodes (§§ 3, 5).

11. As per claim 7, Larsen teaches the invention as claimed, including the method of claim 5 wherein the threshold level is a constant number of levels greater than a level of a balanced portion of the tree data structure (§§ 3, 5).

12. As per claim 10, Larsen teaches the invention as claimed, including a method of performing a rebalancing operation upon a tree data structure comprising the steps of:

(a) allowing a sub-tree of the data tree structure to grow unbalanced to a threshold level greater than one (§§ 1, 3);

(b) developing, in the case where a sub-tree reaches the threshold level (§ 4), first and second sets of rebalancing operation tasks, the first and second set of rebalancing operation tasks operable to effect a first and second set of element state transitions respectively (§ 4, "Split" and "Compress");

(c) performing the first set of operation tasks in a first phase (§ 5); and

(d) performing the second set of operation tasks in a second phase (§ 5).

13. As per claim 13, Larsen teaches the invention as claimed, including a system for deferring the rebalancing of a tree data structure (§ 1) comprising:

(a) a memory for storing the tree data structure (Abstract; § 7) and

(b) a processor coupled to the memory (§ 1), the processor operable to track the performance of operations upon the tree data structure and rebalance the tree data structure when an unbalanced sub-tree of the tree data structure reaches a threshold level greater than one (§§ 1, 3).

14. As per claim 15, Larsen teaches the invention as claimed, including a system comprising:

means for storing a tree data structure (Abstract; § 7);

means for tracking the execution of operations upon the tree data structure (§§ 1, 5); and means for rebalancing the tree data structure when an unbalanced sub-tree of the tree data structure reaches a threshold level greater than one (§ 4), the rebalancing including a first rebalancing phase in which rebalancing operations are executed in parallel and nodes of the unbalanced sub-tree are unlocked (§§ 1, 4, "Split"), and a second rebalancing phase in which different rebalancing operations are executed (§§ 1, 4, "Compress").

15. As per claim 17, Larsen teaches the invention as claimed, including a method of deferring the rebalancing of a tree data structure (§ 1) comprising the steps of:

(a) tracking the performance of operations upon the tree data structure (§§ 1, 3); and

(b) rebalancing the tree data structure when an unbalanced sub-tree of the tree data structure reaches a threshold level greater than one (§ 4), the rebalancing further comprising creating first set of rebalancing operation tasks, the first set of rebalancing operation tasks being characterized by navigation of the tree data structure using at least an existing link (§ 4, "Split"), creating a second set of rebalancing operation tasks, the second set of rebalancing operation tasks being different from the first set of rebalancing operation tasks and being characterized by location of elements within the tree data structure using at least one pointer created by the first set of rebalancing operation tasks (§ 4, "Compress"), and performing at least one operation task of the first set of rebalancing operation tasks in a first phase and at least one of the second set of rebalancing operation tasks in a second phase (§ 5).

16. As per claim 18, Larsen teaches the invention as claimed, including a method of deferring the rebalancing of a tree data structure (§ 1) comprising the steps of:

(a) tracking the performance of operations upon the tree data structure (§§ 1, 3); and

(b) rebalancing the tree data structure when an unbalanced sub-tree of the tree data structure reaches a threshold level greater than one (§ 4),

the rebalancing further comprising executing simultaneous rebalancing operations on the tree data structure (§ 4, "Split") including performing any first phase operation task of each of the simultaneous rebalancing operations in a first phase using parallel processes (§ 5),

developing a set of serial rebalancing operations during the first phase (§ 4, "Split"), and performing any second phase operation task of each of the simultaneous rebalancing operations a second phase (§ 4, "Compress"), the second phase operation task having at least one of the set of serial rebalancing operations (§ 5).

17. As per claim 19, Larsen teaches the invention as claimed, including a method of rebalancing a tree data structure, the method comprising:

allowing a sub-tree of the tree data structure to grow unbalanced until a threshold level is reached (§§ 1, 3);

developing a first set of rebalancing operation tasks, the first set of operation tasks operable in parallel on one or more unlocked nodes of the tree data structure during a first phase of the rebalancing (§§ 1, 4, "Split");

developing a second set of rebalancing operation tasks during execution of the first set of rebalancing operation tasks (§§ 1, 4, "Compress"); and

executing the second set of rebalancing operation tasks during a second phase of the rebalancing (§§ 1, 5).

18. As per claim 20, Larsen teaches the invention as claimed, including the method of claim 19, wherein execution of the second set of rebalancing operation tasks is performed without navigating between nodes of the sub-tree (§§ 1, 4, "Compress").

19. As per claim 21, Larsen teaches the invention as claimed, including the method of claim 19, wherein execution of the first set of rebalancing operations includes generating a list of pointers requiring updating in the second phase of rebalancing (§§ 1, 4, "Split").

20. As per claim 22, Larsen teaches the invention as claimed, including a method of rebalancing a tree data structure, the method comprising:

allowing a sub-tree of the tree data structure to grow unbalanced until a threshold level is reached (§§ 1, 3);

executing a first set of rebalancing operation tasks during a first rebalancing phase, the first rebalancing phase being characterized by navigation between nodes of the sub-tree (§§ 1, 4, "Split");

executing a second set of rebalancing operation tasks during a second rebalancing phase, the second rebalancing phase including navigation being independent of pointers between nodes of the sub-tree (§§ 1, 4, "Compress").

21. As per claim 23, Larsen teaches the invention as claimed, including the method of claim 22, wherein the first set of rebalancing operation tasks are performed on unlocked nodes of the sub-tree (§§ 1, 4, "Split").

22. As per claim 24, Larsen teaches the invention as claimed, including the method of claim 22, wherein the first set of rebalancing operation tasks includes a plurality of operation tasks configured for parallel execution (§§ 1, 4, "Split").

23. As per claim 25, Larsen teaches the invention as claimed, including a method of maintaining a tree data structure, the method comprising:

allowing the tree data structure to grow unbalanced (§§ 1, 3);

performing a first set of rebalancing operation tasks during a first rebalancing phase on a plurality of nodes in the tree data structure, the first set of rebalancing operation tasks being configured for execution while the plurality of nodes are unlocked and for insertion and deletion of nodes (§§ 1, 4, "Split"); and

performing a second set of rebalancing operation tasks on the plurality of nodes in a second rebalancing phase, the second set of rebalancing operation tasks being different than the first set of rebalancing operation tasks and being configured for further operations on the plurality of nodes, the second rebalancing phase occurring after completion of the first rebalancing phase (§§ 1, 4, "Compress").

24. As per claim 26, Larsen teaches the invention as claimed, including the method of claim 25, wherein the first set of rebalancing operation tasks are performed in parallel (§§ 1, 4).

Response to Arguments

25. Applicant argues that Larsen "*teaches that rebalancing should occur based on 'working hours'...or such that there is 'a constant number of operations...per update' (page 196 col. 2 lines 31-32).*" Applicant submits that these factors are not related to the claimed "threshold

level." Applicant also argues with respect to claim 3 that Larsen fails to teach the threshold level being a constant number of levels greater than the balanced portion of the tree.

26. Examiner respectfully submits that Applicant has mischaracterized Larsen. Larsen does not perform rebalancing in response to "working hours", nor is the number of operations related to the timing of the rebalancing operation. Rather, Larsen seeks to minimize the amount of rebalancing that occurs since it is an expensive operation that causes nodes of a data structure to remain locked for long periods of time during the update. Larsen seeks to prevent constant rebalancing, wherein a benefit of delaying the rebalancing is that the operations can be performed after working hours, when the processing overhead incurred would not drag down computers that are in use. Larsen clearly supports "delaying" or "deferring" rebalancing operations, as the specific language used is that the rebalancing operation can be "postpone[d]." (§ 1, col. 2). Larsen defines several variables to support this deferment, including the concept of a "relaxed height" (§ 5). This "relaxed height" allows a sub-tree to grow to a height beyond that which would normally trigger a rebalancing operation. The threshold level is initialized and set once an unbalanced condition has occurred.

27. Applicant argues that Larsen's teaching the maximum height of a node in a relaxed tree being $\log_a(N/2)$ does not read on Applicant's claim of a threshold level of $\log_2 N$.

28. First, it should be noted that while Applicant uses the value of "N" to indicate the number of nodes, "N" is a derived value in Larsen. That is, $N = |T| + i$, where $|T|$ is the size (number of keys) of the tree and i is the number of insertion operations. It is conceivable that the number of keys in a tree would exactly correspond to the number of insertion operations, in which case the

value of "N/2" would correspond to the number of nodes in the tree. Furthermore, Larsen discusses that the value of "*a*" is the minimal node size. This value must be 2 at a minimum, as 1 node would not be a tree at all. In such a situation, the maximum depth of a sub-tree would be $\log_2 N$, as claimed. It is granted that there may be other scenarios for the values in this equation, but the teachings of Larsen do read on claim 2 in their broadest interpretation.

29. Applicant requests a specific identification of where the "Split" and "Compress" operations are shown as being executed in separate phases. Larsen discusses the rebalancing operations are performed by first performing the "Split" operations, which adjusts the placement of nodes the routing information to reach those nodes. Subsequently, the "Compress" operations traverse the tree and update the pointers such that there are not extraneous pointers that are not needed. That one set of operations follows the other indicates that they are executed in separate phases. Furthermore, with respect to claim 17, "Split" must navigate the tree data structure using an existing link, i.e. pointer, as the routing information for nodes that are moved must be updated. There is no way that this can occur without traveling along pointers that are already in existence. The "Split" operation creates new pointers to update the routing information of the nodes that have been moved, wherein the "Compress" operations remove redundant pointers. In this manner, the "Compress" operations use pointers that were created by the "Split" operations.

Conclusion

30. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Syed J Ali whose telephone number is (571) 272-3769. The examiner can normally be reached on Mon-Fri 8-5:30, 2nd Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng-Ai T An can be reached on (571) 272-3756. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Syed Ali
August 24, 2005

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